The Economic Impact of the California High-Speed Rail in the Sacramento/Central Valley Area

Simulation Artwork from NC3D

Prepared by:

Shawn Kantor, Ph.D.
County Bank Professor of Economics
University of California, Merced

September 2008

The Economic Impact of the California High-Speed Rail in the Sacramento/Central Valley Area

prepared by:

Shawn Kantor, Ph.D.

EXECUTIVE SUMMARY

The Central Valley will experience unprecedented growth over the next 20 years, placing critical strains on existing transportation infrastructure. The Central Valley today is relatively inconveniently integrated into the major economic areas of the state in the Bay Area and in Southern California. High-speed rail (HSR) is a transportation option that has proven effective around the world in reducing automobile and airline traffic, while integrating wider geographic regions into a unified economic market.

This report highlights some of the most obvious economic benefits associated with implementing HSR over the alternatives of expanding the freeway and airway networks. The most directly obvious cost savings accruing to Central Valley residents fall into the four categories of mode-shift benefits, congestion reduction benefits, market accessibility benefits, and the social benefits associated with reduced air pollution and accidents. The available research on how transportation dynamics would shift as a result of new modal options combined with information on the value people place on their time and clean air shows that these overall direct benefits could amount to approximately $3 billion. The largest component of the savings would be the value of time recouped from avoiding traffic.

The research suggests that HSR will have a disproportionately positive impact on areas that are on the economic periphery at the present time, specifically Merced and

Madera Counties. The research further indicates that HSR will trigger internal job creation within the Central Valley, especially in the service, transportation, communications, and utilities, and finance, insurance, and real estate sectors. Further, job-creation will occur directly as a result of the HSR network construction. With 160,000 construction-related jobs created to plan, design, and then build the HSR system at an approximate cost of $40 billion, the Central Valley economy will experience direct employment and economic multiplier benefits. It is reasonable to speculate that the Central Valley will receive somewhere between 15 and 40 percent of the overall HSR public expenditure, based on population and track mileage.

One of the most important anticipated benefits from HSR is the increased level of accessibility that Central Valley areas will experience. Lower transportation and transaction costs will encourage new businesses to locate in the Central Valley where favorable costs and public policies can encourage business development. Workers will be able to seamlessly commute both to, from, and within the Central Valley. Estimates presented in the report show that the potential taxable income gains to the Central Valley economy from achieving economic integration into and parity with the rest of the state can reach nearly $48 billion per year. This added income would translate into enhanced state income tax revenues of over $2 billion. Furthermore, increased household income translates into greater consumption. Estimates presented in the report suggest that total sales/use taxes would increase by approximately $333 million per year, of which nearly $46 million would flow directly to counties and cities within the Central Valley.

Economic research uniformly finds that transportation convenience and accessibility is a key determinant of real property values, both residential and

commercial. HSR is predicted to have a positive impact on property values, yet research on HSR's impact elsewhere in the world shows the importance of land-use planning policies that steer growth toward infill and redevelopment efforts.

Finally, the study highlights some of the more subtle anticipated benefits of HSR. First, HSR represents a major infrastructure investment in the Central Valley. Given the distribution of income and wealth within the state, Central Valley residents and taxpayers will pay a disproportionately diminished share of the revenue needed to fund HSR in California. Second, the study indicates some of the quality of life benefits associated with HSR. HSR will reduce the amount of traffic on freeways, thus resulting in a reduced level of airborne pollutants, not only in the Central Valley but also in the Bay Area that serves as a source of pollution for inland regions. HSR will use less open-space land than the alternative – freeway construction – and the location of HSR stations can serve as a focal point for sustainable local development.

The Economic Impact of the California High-Speed Rail in the Sacramento/Central Valley Area

prepared by:

Shawn Kantor, Ph.D.

I. Introduction

After four years delay California voters will be asked to approve Proposition 1A – also known as the "Safe, Reliable High-Speed Passenger Train Bond Act for the 21st Century" – on November 4, 2008.[1] If approved, the Act would enable the state to issue $9.95 billion in general obligation bonds to develop high-speed rail (HSR) in California. Nine billion dollars would be used to fund the planning and construction of the high-speed rail system, while the remaining $950 million dollars of the bond revenue would be used for capital improvements to other passenger rail lines that would connect to the HSR system. Heavy rail systems (e.g., the Los Angeles County Metro Rail and the Bay Area Rapid Transit), commuter rail lines (e.g., Metrolink in the Los Angeles area and Caltrain in the Bay Area), light rail systems (e.g., the San Diego Trolley and the San Francisco Muni), and intercity rail would all benefit from capital improvements funded by the bond measure.

California's population is expected to increase by over 30 percent in nearly 20 years and by over 50 percent in 40 years, placing increasing pressure on the state's

[1] The present Act (AB 3034) was originally to be put before voters during the November 2, 2004, General Election, but was subsequently delayed to the 2006 General Election (Senate Bill 1169, Chapter 71, Statutes of 2004). Yet further legislation in 2006 pushed the vote on the bond measure to the present 2008 General Election (Assembly Bill 713, Chapter 44, Statutes of 2006). See the California Secretary of State Ballot Measure Update at http://www.sos.ca.gov/elections/elections_j.htm#2008General.

transportation infrastructure.[2] As an alternative to the state's traditional reliance on expansive freeways and airports, the envisioned HSR system would connect the major population areas of the state with over 800 miles of mostly dedicated, fully grade-separated track with technologically advanced safety and control systems. By 2030 the system is projected to accommodate 117 million passengers. With trains operating at speeds of over 200 miles per hour, the metropolitan areas of San Diego, to Los Angeles, through the Central Valley and Sacramento, to the Bay Area would be inter-connected in a manner that would bring significant benefits to Californians.[3]

The most direct benefit of the HSR would be that it would provide the opportunity for long-, intermediate- and relatively short-distance trips, serving a wide range of travelers, whether for business, daily commuting, or leisure. The high-speed train would be a strong viable transportation alternative for relatively longer distance travel as door-to-door travel times would be comparable to air travel and less than one-half as long as an automobile trip. Moreover, for some voyages between cities that are presently un-served or under-served by air transportation, HSR travel times and convenience will make that mode of transportation significantly more attractive than air or automobile travel. The objective research shows that high-speed train travel provides a relatively safe, reliable, efficient, and cost-effective means of transportation.

In the terms of the environmental benefits of HSR, electrically-powered high-speed trains would reduce Californians' reliance on gasoline consumption. With an expected 117 million passengers annually by 2030, along with the transport of

---

[2] See the California Department of Finance population projections at http://www.dof.ca.gov/html/DEMOGRAP/ReportsPapers/Projections/P3/P3.php.

[3] The foregoing benefits are highlighted by the California High Speed Rail Authority. See http://www.cahighspeedrail.ca.gov/faqs/benefits.htm.

lightweight freight, HSR is anticipated to save 12.7 million barrels of oil per year by 2030. By providing an attractive, cost-effective alternative to cars and planes, the California high-speed train system is estimated to be able to reduce CO_2 emissions by up to 12 billion pounds per year by 2030. In addition, HSR will lead to more sustainable land use. While freeway expansion tends to encourage urban sprawl, high-speed train stations serve as a focal point for growth that stimulates denser infill development that links directly with local and regional transit systems, airports, and freeway systems. Moreover, by using existing transportation corridors, the HSR will have less of an impact on California's open spaces.

In addition to environmental benefits, the HSR system as a whole would produce important spillover benefits (or "positive externalities") that Californians who never anticipate riding on a high-speed train will enjoy. For example, as travelers shift from automobiles to trains, the reduced congestion and accident danger on freeways will benefit those who remain in their cars. Moreover, the HSR network is expected to provide grade separations, so traffic delays at existing at-grade crossings will be diminished to the extent that the HSR separates the grades of all tracks where the HSR system shares rights-of-way. Perhaps the most significant positive externality of HSR is the expanded economic activity resulting from lowering the transportation costs of a region and expanding its accessibility to broader product and labor markets.

The diverse socioeconomic and economic characteristics of the state's various regions make it difficult to over-generalize the anticipated benefits of the HSR proposal. Therefore, careful consideration of the nuanced situation in each region can provide better insight into the HSR's potential impacts across the state. One facet of the proposed

HSR network stands out clearly: 48 percent of the track will be laid in the Central Valley. The Central Valley is poised for rapid change over the next twenty years, largely driven by the anticipated large influx of new residents. While the region is known worldwide for its prominence in agricultural production, the Central Valley lags behind the state in many important indicators of economic prosperity and faces many challenges moving forward. Average per capita incomes are 32 percent lower than the rest of the state, college-level attainment is about half the state's average, unemployment is higher, crime is higher, access to healthcare is lower, and air quality is notoriously poor.[4] Given the importance of the Central Valley to the state's overall economy and in light of the many disadvantages the region currently faces, Governor Arnold Schwarzenegger signed Executive Order S-5-05 in June 2005 forming the California Partnership for the San Joaquin Valley. Public and private leaders agreed upon a vision and roadmap for advancing economic prosperity, environmental quality, and social equity within the San Joaquin Valley and delineated specific metrics to judge the plan's success. Among the six major initiatives emphasized by the Partnership was the need to "build innovative transportation systems to increase travel choices and improve mobility, regional and state goods movement, air quality, and economic prosperity."[5] One of the ten goals under this initiative was to "assure the high-speed rail system, if implemented, supports the San Joaquin Valley in achieving its economic, environmental, land use, and mobility goals."[6]

[4] California Partnership for the San Joaquin Valley (October 2006, p. 13).
[5] Ibid., p. 42. For additional economic research confirming the idea that transportation infrastructure has a positive impact on economic development, see Aschauer (1989), Munnel (1990a,b), Nadiri and Mamuneas (1994), Chandra and Thompson (2000), and other research referenced in Baird (2005).
[6] Ibid., p. 45.

The goal of this research report is to explore more fully the expected benefits that would accrue to Central Valley / Sacramento area residents.[7] The next section of the report details the direct expected benefits that would be realized, including the direct benefits from shifting to more cost-effective means of transportation, as well as the social benefits from reduced air pollution and accidents. The third section considers the economic impact of HSR on Central Valley communities. Population and employment growth, the direct benefit from the construction project, the economic benefits from market integration, the impact on government revenues, the influence on the real estate market, and the fiscal consequences to Central Valley residents associated with public expenditure of HSR are all analyzed. Section four explores how HSR can affect aspect of quality of life in the Central Valley that citizens value, including land use and pollution. The final section offers concluding remarks on the economic benefits of HSR in the Central Valley and Sacramento area.

II. The Direct Costs Savings Anticipated from HSR

The most obvious benefit from introducing HSR is the direct cost savings associated with a faster, safer, and cleaner transportation alternative. The direct cost benefits can be categorized into four broad areas – mode-shift benefits, benefits from congestion reduction, market accessibility benefits, and social benefits in the form of reduced air pollution and accidents.[8] So-called mode-shift benefits are calculated as the

[7] For the purposes of this report, the "Central Valley / Sacramento" region includes Fresno, Madera, Merced, Sacramento, San Joaquin, and Stanislaus Counties. The "South Sacramento Valley" includes El Dorado, Placer, Sutter, Yolo, and Yuba Counties, while the "South San Joaquin Valley" includes Kern, Kings, and Tulare Counties. This geographic categorization follows the California High-Speed Rail Authority and USDOT Federal Railroad Administration (May 2008, p. 5-3) usage.

[8] Market accessibility benefits are discussed below in Section III.

savings that travelers receive as a result of shifting their mode of travel from relatively expensive – at least from the traveler's perspective – automobiles, airplanes, and conventional trains to HSR. For example, consider the case of a traveler who wishes to go from Fresno to San Francisco. Using HSR instead of a car would save the traveler valuable time, lead to differences in out-of-pocket expenses between the two modes of travel (gas, wear and tear on a car, tolls, and parking less the price of an HSR ticket), enable the passenger to be more productive by, say, working or making phone calls during the train ride, and would expose the traveler to less accident risk than driving. Another form of mode-shift benefit would be generated by people who do not take trips today because of the prohibitive cost of driving or flying, but would be induced to take the HSR for an otherwise avoided trip. Calculating the benefit that the traveler places on taking the trip, less the cost of the trip, which is what economists refer to as "consumer surplus," is a form of economic benefit to be estimated. As part of the analysis conducted for the environmental impact review, Cambridge Systematics (2007) provided a rigorous calculation of the mode-shift benefits that would accrue to the Central Valley as a result of the HSR's introduction. The study found the expected benefits to be $780 million (see Table 1).[9]

Congestion-reduction benefits refer to the social savings resulting from the decreased travel times induced by the HSR. The HSR will induce some travelers to shift from driving or flying in favor of HSR, thus providing a positive spillover benefit to those individuals who would continue to drive their own cars or use air transportation.

[9] In an interesting empirical study of residential choice in the Bay Area, Schwanen and Mokhtarian (2007) found that residents desire to reduce their automobile usage for environmental reasons dictated their decision to live in high-density areas. One mode-shift benefit that would be very difficult to measure is the added consumer surplus or happiness accruing to citizens who value environmental protection and would be able to use HSR instead of their cars.

Table 1
Direct Benefits of High-Speed Rail in Central Valley Regions (1,000s dollars)

Region	Mode-Shift Benefits	Auto Delay Reduction	Accident Reduction	Air Pollution Reduction	Air Delay Reduction	Total
Central Valley	$581,517	$1,236,941	$219,645	$28,968	$2,305	$2,069,376
Southern Sacramento Valley	116,437	109,744	14,277	1,882	245	242,585
Southern San Joaquin	82,247	635,200	132,593	17,487	55	867,582
Total	780,201	1,981,885	366,515	48,337	2,605	3,179,543

Source: Cambridge Systematics (2007, p. D-2).

As HSR became more widely used by commuters and other passengers, it would lead to less congestion on highways and in airports. Freeway gridlock during peak travel times would be reduced, as would airport waiting times. Not only would travelers benefit if their flights could leave and arrive as scheduled, but the airline industry would reap benefits as well as aircraft operating delays were reduced. Cambridge Systematics calculated the benefits accruing in the Central Valley from reduced automobile delays to be nearly $2 billion, while the reduction in air delays specific to the region would be a relatively modest $2.6 million.

The direct social benefits that would accrue to society at-large as a result of HSR also include the reduction in pollution and automobile accidents. HSR's safety record around the world is extraordinarily good – nearly zero – and extremely low compared to automobile travel. By shifting travelers from cars to trains would not only reduce property damage, but also save lives. The economic value of these cost savings, as calculated by Cambridge Systematics, is expected to be $366 million in the Central

Valley regions. Moreover, by reducing automobile traffic, less pollutants would be emitted into the air. Combining an estimate of the reduction in automobile usage based on a travel demand model with the value society places on pollution abatement, Cambridge Systematics forecast the cost saving in this area to be $48 million in the Central Valley regions.

While this research points to the obvious direct cost savings that individuals and society might recapture as a result of HSR, there remains the possibility that another means of transportation might reap even more cost savings. Thus, a comparative look at the relative cost of different means of transportation for the same trip must be considered. Along this line of comparative work, Levinson et. al. (1996) and Levinson et. al. (1999) calculated the costs of providing transportation services by highway, air, and high-speed rail along the California Corridor (Los Angeles to San Francisco). While not taking into account the full complement of potential benefits to individuals and society as a result of relying on each mode of transportation, they concluded that the most cost effective high-speed rail configuration was one that competed directly with highway travel. Their analysis showed that for relatively long trips, expanding the air infrastructure was more cost-effective (again, the benefit side of the equation was not considered). These results are very important from the Central Valley's perspective because many Central Valley areas, with relatively inconvenient air access to major metropolitan areas, must rely on the freeway to reach major markets. The Levinson et. al. results indicate that Central Valley travelers and citizens would disproportionately gain from the HSR when viewed in comparison to the alternative of expanding freeways. Recent research from around the world, however, has shown that HSR can even serve as an effective counterpart to air

travel on longer-distance routes, such as Los Angeles to San Francisco (see, for example, Eichenger and Knorr 2004, Park and Ha 2006, and Román et. al. 2007).

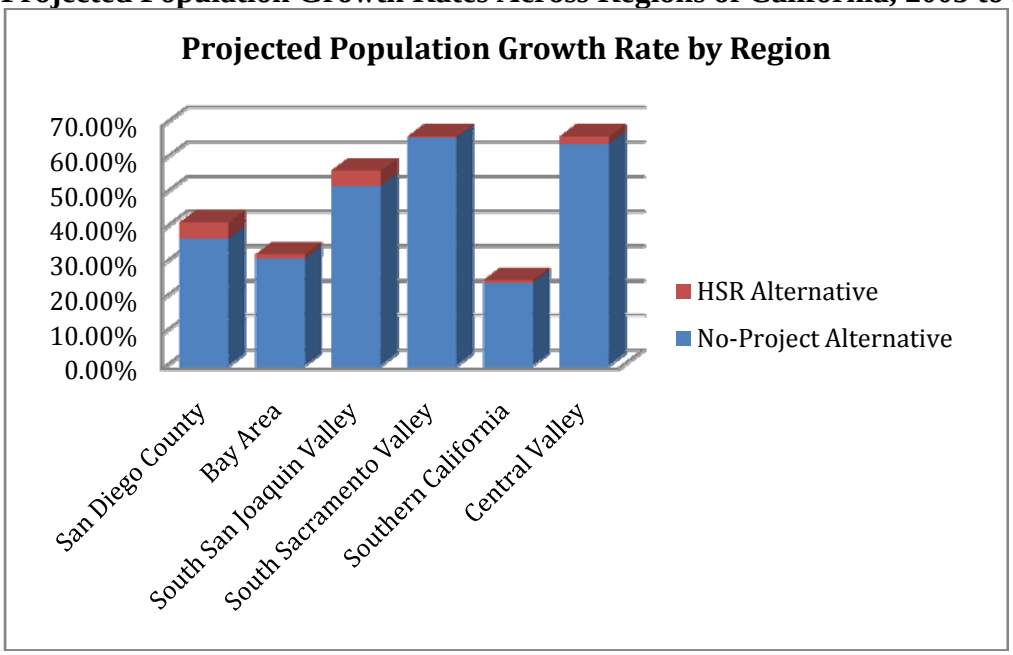
III. The Effects of HSR on the Central Valley Economy

A. Population and Employment Growth

The Central Valley's population will grow dramatically over the next 20 years, which will occur with or without HSR. The question remains, however, to what extent can reduced transportation costs and increased accessibility to extended regions induce even greater population growth. With improved access some people may come to see Central Valley cities as "bedroom communities" to major metropolitan labor markets or the reduced transportation costs could induce employers to move to the Central Valley for its reduced costs of operation. While the labor pool may not necessarily meet the technical needs of some employers, the expectation may be that HSR could provide a means for workers to reach new employment opportunities.

The blue bars in Figure 1 show the estimated population increase across California regions from 2005 to 2030; the red bars indicate the forecasted added population growth if HSR is introduced. HSR may cause population across the state to increase because of business expansion into the state or expansion of businesses already operating within the state. Alternatively, HSR may cause disparate population growth rates across regions as businesses or residents find it feasible now to reallocate to lower-cost, more readily accessible areas of the state.

Figure 1
Projected Population Growth Rates Across Regions of California, 2005 to 2030

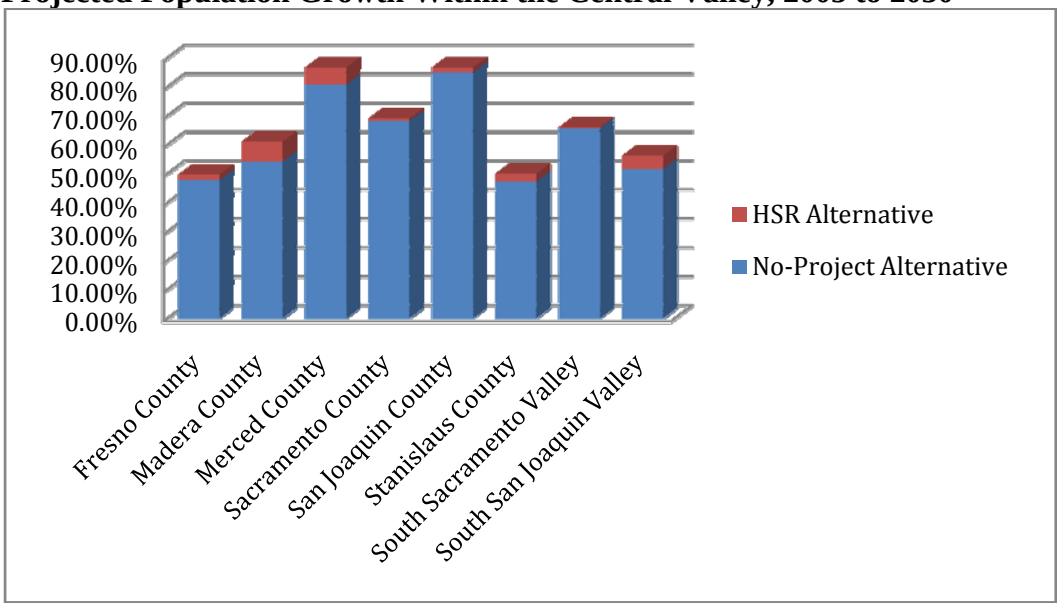


Source: California High-Speed Rail Authority and USDOT Federal Railroad Administration (May 2008, p. 5-8).

As the figure makes clear, under the "no-project alternative," population growth in the Central Valley will soar in comparison to other regions of the state. While the Central Valley, Southern Sacramento Valley, and Southern San Joaquin Valley population expectedly will increase 63.9, 65.7, and 51.7 percent, respectively, the Bay Area, Southern California, and San Diego will increase by 30.8, 23.8, and 36.4, respectively. When considering the regions as a whole, HSR would only add modestly to these growth rates. Only the Southern San Joaquin Valley and San Diego would experience significant gains on the order of a five percentage point increase in their respective growth rates.

The overall regional expectations mask important changes that would occur within the Central Valley if HSR were to be implemented. Figure 2 shows the expected population growth rates within Central Valley counties both with and without HSR.

Figure 2
Projected Population Growth Within the Central Valley, 2005 to 2030

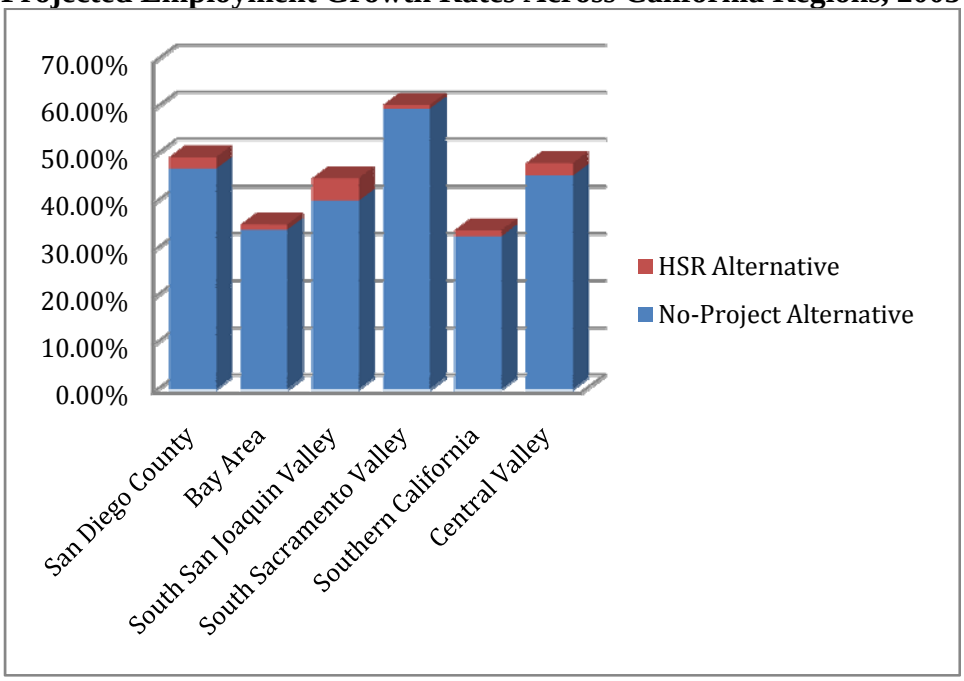


Source: California High-Speed Rail Authority and USDOT Federal Railroad Administration (May 2008, p. 5-8).

While Merced and San Joaquin Counties are both expected to grow by over 80 percent over the next 20 years, Merced would benefit most from HSR as its population will increase five percentage points as a result of the train's introduction. Madera County would similarly benefit from HSR.

Projected employment growth rates reveal the same trends as the population figures (see figure 3). The South Sacramento Valley, San Diego, and Central Valley regions are expected to experience relatively high employment growth rates of 59.6, 46.9, and 45.4, respectively, even without HSR. Yet the largest marginal increases associated with HSR will accrue to the Southern San Joaquin counties. HSR there will increase employment growth rates from 40.1 without the train to 44.8 percent with it. Both the Central Valley and San Diego would benefit from measurable employment growth as a result of HSR.

Figure 3
Projected Employment Growth Rates Across California Regions, 2005-2030



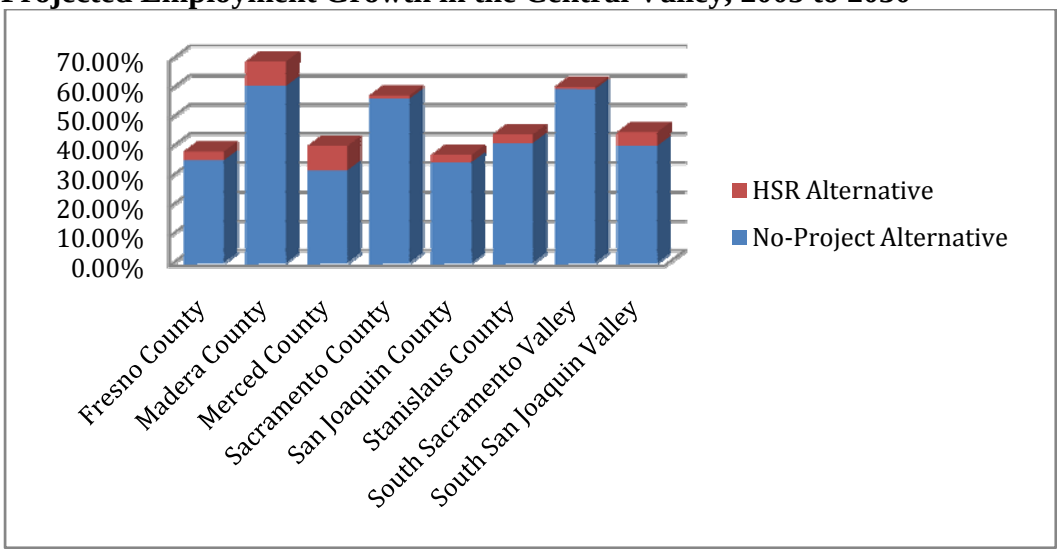
Source: California High-Speed Rail Authority and USDOT Federal Railroad Administration (May 2008, p. 5-9).

As shown by the blue bars in Figure 4, the baseline employment growth rates within the Central Valley would be most heavily concentrated in Madera County, Sacramento County, and the South Sacramento Valley area. Again, however, like the population growth rates, both Merced and Madera Counties stand to gain significantly from HSR, and the South San Joaquin Valley area to a smaller, yet important, effect.

Creating more efficient transportation access to the heart of the Central Valley region, which tends to be inaccessible to major metropolitan areas because of the cost of travel, would have a disproportionately positive employment impact from HSR. Haynes's (1997, p. 69) survey of research on the *Shinkansen*, Japan's high-speed rail system, revealed that "although growth parallels the high-speed train route, the route was selected due to expected growth independent of the high-speed train. However, the route and stations dispersed growth from existing (pre-train) centers to sub-centers where high

access points (stations and expressways) were located and these high access points attracted indigenous growth within local areas which complement and accentuate these new growth sub-centers." The Japanese experience offers important insights into the potential impact of HSR within the Central Valley of California.

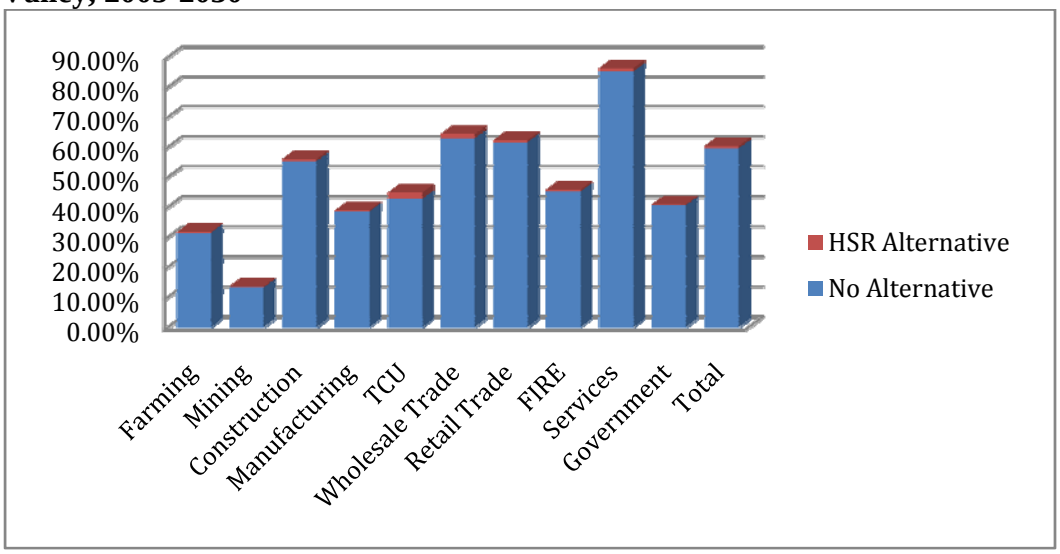
Figure 4
Projected Employment Growth in the Central Valley, 2005 to 2030



Source: California High-Speed Rail Authority and USDOT Federal Railroad Administration (May 2008, p. 5-9).

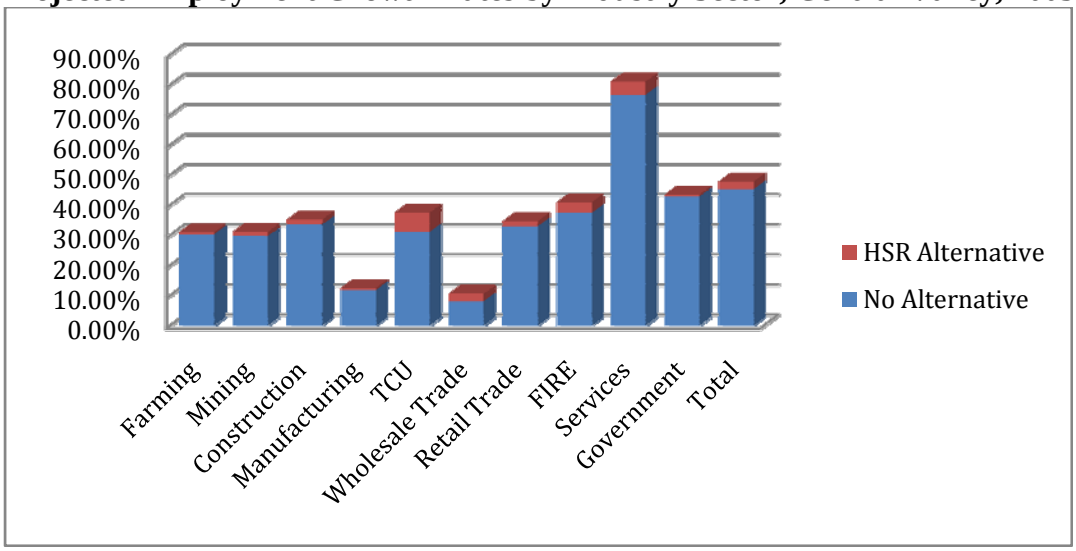
The overall employment growth figures do not give a flavor for the nature of the job-creation that will occur within the Central Valley, regardless of the HSR's implementation. Figures 5a-c show the projected employment growth rates from 2005 to 2030, by industry sector, for the Southern Sacramento Valley, Central Valley, and Southern San Joaquin Valley, respectively. The figures are based on estimates computed from an economic growth model that predicts how business costs savings from lower transportation costs, business attraction to an area, and quality of life enhancements as a result of improved transportation can trigger economic growth.

Figure 5a
Projected Employment Growth Rates by Industry Sector, Southern Sacramento Valley, 2005-2030



Source: Calculation based on data in Cambridge Systematics, Inc. (2007, pp. G-2-G-4).

Figure 5b
Projected Employment Growth Rates by Industry Sector, Central Valley, 2005-2030

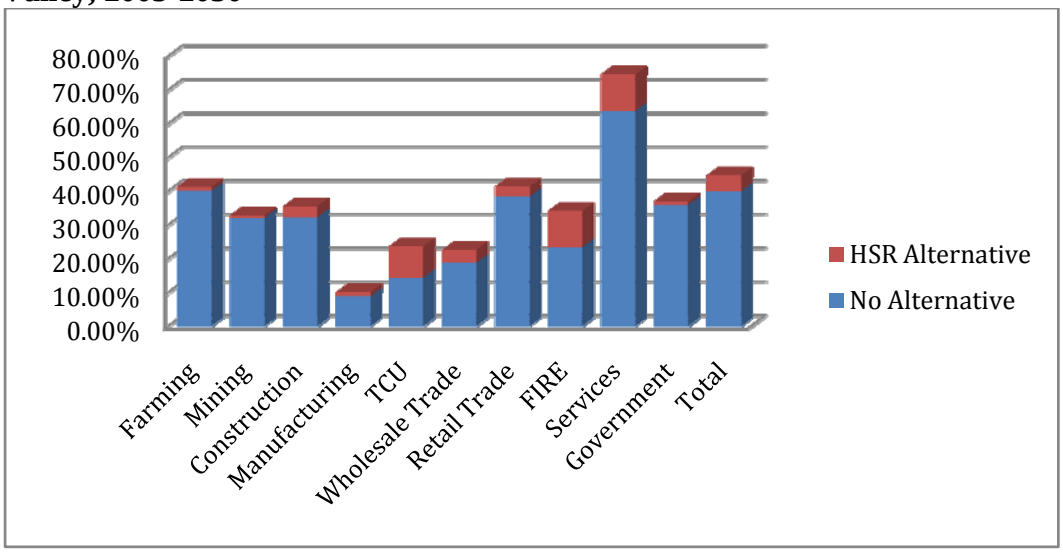


Source: Calculation based on data in Cambridge Systematics, Inc. (2007, pp. G-2-G-4).

While the Southern Sacramento Valley will experience significant job-growth in the service sector, retail and wholesale trades, and construction over the next 20 years, the HSR will only have a marginal impact on employment growth there (also shown in Figure 4). The Central Valley and Southern San Joaquin Valley will experience

explosive growth in the service sector, which will be significantly amplified as a result of HSR. In the Central Valley, HSR is projected to increase service sector employment by 4.5 percentage points and by 10.8 points in the Southern San Joaquin Valley. The transportation, communications, and utilities sector will grow significantly in both regions as a result of HSR – 6.7 percentage point growth in the Central Valley region and 9.3 percentage points in the Southern San Joaquin. Finance, insurance, and real estate (FIRE) would also grow disproportionately with the introduction of HSR, but again much more dramatically in the southern part of the overall Central Valley.

Figure 5c
Projected Employment Growth Rates by Industry Sector, Southern San Joaquin Valley, 2005-2030



Source: Calculation based on data in Cambridge Systematics, Inc. (2007, pp. G-2-G-4).

B. Direct Impact from HSR Construction

The California HSR project will be a job-creator in its own right. The High-Speed Rail Authority estimates that 160,000 construction-related jobs will be created to plan, design, and then build the HSR system at an approximate cost of $40 billion. As an estimate of the possible direct employment and construction benefits accruing to the

Central Valley, consider that about 40 percent of the track that will be laid is within the Central Valley, yet the region only has 15 percent of the overall population residing near the HSR system. These figures provide a range of possible direct expenditures that will occur within the Central Valley – somewhere between $6 and $16 billion. This amount of public expenditure will lead to significant economic multiplier effects as Central Valley contractors, sub-contractors, workers, retailers, and local governments experience the direct and indirect effects of the HSR's construction.

C. Market Integration

Over the last decade economists have devoted increasing attention to the factors that lead to market and geographic integration. Throughout the course of human history, transaction costs, including, but not limited to, transportation costs, have dictated the ability of regions to engage in specialization and trade. Reduced travel times and costs enable consumers to access more distant markets, enable producers to deliver products to their consumers at lower cost, enable workers to access more distant labor markets, or enable employers to tap into a wider labor pool themselves.[10] Because transaction costs have historically been relatively high, the urban area has served as a focal point for producers, consumers, workers, and employers because it was simply less costly to conduct business if everyone was in relative close proximity. The fact that consumers and producers tend to co-locate leads to further "agglomeration" benefits as business tend to find it easier to operate if they are able to more easily access technology, wholesalers, workers, consulting services, or anything else that enables them to produce as efficiently

[10] For a spatial analysis of HSR's impact on accessibility in the European context, see Gutiérrez et. al. 1996.

as possible. Agglomeration effects tend to be self-reinforcing: the bigger and more powerful industries and firms become, the more likely that others (businesses, consumers, and workers) will want to be near them.[11]

A reduction in transportation costs, however, can turn the benefits of agglomeration on its head. In a paper offering a fairly radical prediction, Glaeser and Kohlhase (2004) predict that because transportation costs in the modern era have fallen dramatically, which HSR would facilitate, there is no longer a need for cities to be near natural resources or transportation hubs. "Instead, cities should locate where it is pleasant to live or where governments are friendly" (p. 225). While agglomeration economies will continue to be important for a region's economic success, the reduction in transportation costs that HSR facilitates enables the economic hub to expand so that a wider geographic region becomes integrated.[12]

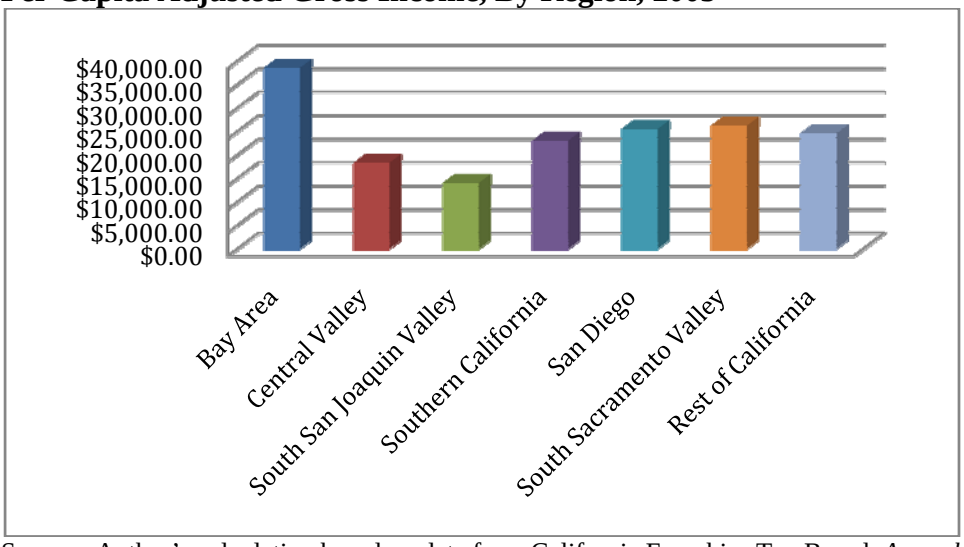
Sands (1993) provides a useful case study of the TGV Atlantic line between Paris and Le Mans, analyzing how the HSR affected economic development in the broader region. Sands's analysis of Nantes, France provides insights into the potential impact that HSR may have on relatively larger, economically diverse economies within the Central Valley. Nantes is two hours outside Paris by high-speed train, yet firms became much more likely to relocate to the peripheral city as a result of the easy access to Paris. For example, the Waterman Company, which sells writing instruments worldwide, relocated from Paris to Nantes because it could build a new headquarters in Nantes for the cost of two years rent in Paris. Waterman conducts its sales and marketing projects in

[11] On the economic importance of agglomeration, see Porter (2003).
[12] Indeed, researchers have begun to study how HSR affects the accessibility of extended geographic areas, particularly in the European setting. See, for example, Martín and Reggiani (2007) and Garmendia et. al. (2008).

Paris by sending employees via the TGV. If this trend were to follow suit in California, one could easily envision Bay Area firms relocating to the Central Valley to benefit from lower property/rental costs and a cheaper labor force. To the extent that the appropriate skilled labor is not available, HSR provides the opportunity for commuting from the tradition center to the periphery.

Standard economic theory would predict that as transportation costs fall, product market prices and input prices should converge. Incomes should begin to converge for areas that traditionally were separate product and labor markets. Clearly there is evidence of such separation in California today. Figure 6 shows per capita adjusted gross individual income (AGI), as reported to the California Franchise Tax Board in 2005, by region. The figure shows the Central Valley and South San Joaquin Valley significantly lagging behind the other regions, while the South Sacramento Valley is roughly comparable to San Diego and slightly ahead of the Southern California region.

Figure 6
Per Capita Adjusted Gross Income, By Region, 2005



Source: Author's calculation based on data from California Franchise Tax Board, *Annual Report, 2006*, Table B-6: Synopsis of Adjusted Gross Income by County, 2005 Taxable Year.

As an illustration of the potential income gains, and resulting income tax benefits to the state, that would be achievable if the Central Valley regions were able to reach full parity with the rest of the state, consider the following thought experiment. The average per capita AGI in the three Central Valley regions was approximately $18.4 thousand in 2005, but $26.4 thousand in the remainder of the state. Multiplying this $8 thousand difference by the population in the Central Valley regions (approximately 5.99 million) yields a potential increase of almost $47.9 billion in total adjustable gross income annually. Based on the average tax rate within the state, this increase in income would add approximately $2.2 billion annually to the state's general revenues.[13] This figure is obviously a lower bound estimate of the benefits to the state, as higher incomes would lead to second-order benefits associated with reduced spending on social programs to alleviate poverty and unemployment. While there are many factors at play that presently cause the Central Valley to lag behind the rest of the state economically, improved transportation and market accessibility is one important factor that would facilitate the region's convergence toward parity with the rest of the state. The HSR would help to serve this role

Another hypothetical experiment to conduct is to assume that the market integration would enable the Central Valley regions to achieve a level of taxable sales that is on par with the rest of the state. On a per capita basis, Central Valley region residents pay sales and use taxes on $14,613 worth of goods and services; the rest of the state has an average per capita amount of $15,380. Central Valley regional parity would

[13] Even measuring the Central Valley's parity with the next highest region (Southern California) yields sizable potential income gains. If Central Valley's adjusted gross income achieved parity with Southern California's, income would grow in the Central Valley by $27.4 billion annually and result in a $1.25 billion increase in state income tax revenue.

imply that taxable sales and use would increase by approximately $4.6 billion (that is, $767 increase in per capita sales times 5.99 million people). Table 2 shows the annual tax revenue that would be generated as a result of the hypothetical increase in sales/use resulting from market integration. According to this calculation, total sales/use taxes would increase by approximately $333 million, of which $46 million would flow directly to counties and cities. This figure does not take into account any specific sales/use taxes that individual counties or cities may levy. Moreover, the calculation only takes into account the assumed parity in consumption occurring within the Central Valley, and holds everything else constant, such as any population increases that might occur over time.

Table 2
Hypothetical Sales/Use Tax Revenue Resulting from an Increase in the Central Valley's Consumption

Tax Rate	Source of tax	Amount of revenue from $4.6 billion increase in sales/use
4.75%	State (General Fund)	$218,454,728
0.25%	State (Fiscal Recovery Fund)	$11,497,617
0.50%	State (Local Revenue Fund)	$22,995,235
0.25%	State (General Fund)	$11,497,617
0.50%	State (Local Public Safety Fund)	$22,995,235
	Local (County/City)	
	0.25% County transportation funds	
1.00%	0.75% City and county operations	$45,990,469
7.25%	Total	$333,430,901

Source: Author's calculations based on data from California State Board of Equalization, *Annual Report 2006-2007*, Table 20: State Sales and Use Tax Statistics, by County, 2006-07. Tax rates reported by the Board of Equalization at http://www.boe.ca.gov/news/sp111500att.htm.

D. The Impact on Real Estate

The value of real estate, either commercial or residential, is determined by the value of its bundled attributes. Economists devote significant effort attempting to

measure what are known as the hedonic values of the bundled attributes that comprise an individual property. For example, different houses have different square footage, lot sizes, number of bedrooms, bathrooms, different floor plans, nicer views, pools, or other amenities. In addition, a critical determinant of a property's value is its location. Research has consistently shown that houses in areas, for example, with better schools, better weather, more community amenities, or better access to transportation links command higher prices. Based on this hedonic pricing logic, HSR's ability to reduce transportation times and costs, opening Central Valley communities to wider economic markets, will necessarily lead to higher property values as such real estate becomes more desirable. Research from European HSR suggests that the effect will be stronger in areas having a station stop and will depend on the planning put forth in creating local development conducive to taking full advantage of the HSR system (see, e.g., Cervero 1994, Vickerman 1997, and Givoni 2006). So-called Transit Oriented Development (TOD) is often associated with the development of new transit lines and, in fact, local planning is currently underway in anticipation of California's proposed HSR.[14] Both commercial and residential values are predicted to experience positive price appreciation as businesses move to Central Valley areas that are conveniently served by HSR, thus putting upward pressure on existing land and housing stocks.

The precise impact on real estate values is difficult to predict, especially in light of the volatile state of real estate markets within the Central Valley, but previous research offers some insights. Economics Research Associates (ERA, 2006) conducted a survey of existing studies to understand the potential transit-oriented-development impacts of

[14] See, for example, Center for Global Metropolitan Studies, University of California, Berkeley (July 31, 2008).

anticipated commuter rail and bus rapid transit expansions in Austin, TX. ERA found that all of the studies consulted agreed on the following points: rail-based transit can have a positive impact on real property values; properties within walking distance experienced the greatest price appreciation; the price effect deepened over time as the system and usage matured; properties located in densely populated settings experienced relatively greater increases; and TOD can be financially successful with appropriately supporting local policy and adequate market demand.

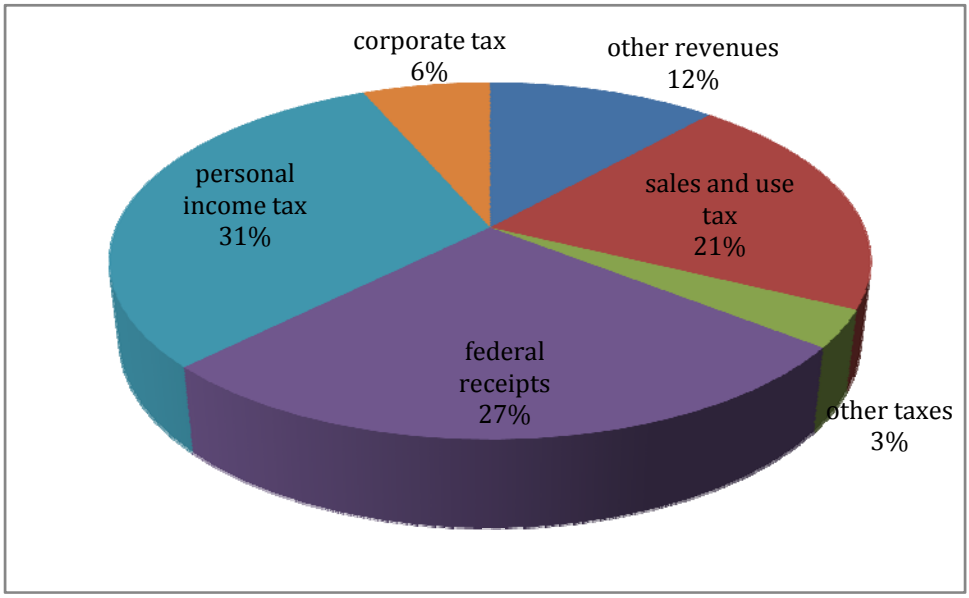
E. Distributional Fiscal Implications of HSR

There is one additional important point to raise about the benefits surrounding HSR from the Central Valley's perspective. As argued above, the region is on the cusp of a demographic and socioeconomic transformation. The public policy decisions that citizens of the region take today in anticipation of these forthcoming changes will have profound ramifications for the future development of the region. The state is offering residents of the Central Valley the opportunity to support the investment in an infrastructure project that can significantly shape the course of this projected economic development. What voters of the forthcoming bond measure might fail to realize is the favorable fiscal deal being offered them. The state's initial $9.95 billion investment in the HSR project, funded through General Obligation bonds, is seen as a critical component in securing downstream funding from federal and local sources, as well as from private partnerships (Infrastructure Management Group/Lehman Brothers Team 2007). This initial state investment will be paid back over time by general revenues.

It is worthwhile to place the source of these state revenues into some perspective. Figure 7 shows the breakdown in the sources of California state revenues in 2007.

Thirty-one percent of California's revenues are derived from the personal income tax and 21 percent is from the state sales and use tax, and another 27 percent is transferred from the federal government. Thus, California citizens are directly taxed and pay for over half of the state's budget.

Figure 7
Distribution of California State Revenues, 2007

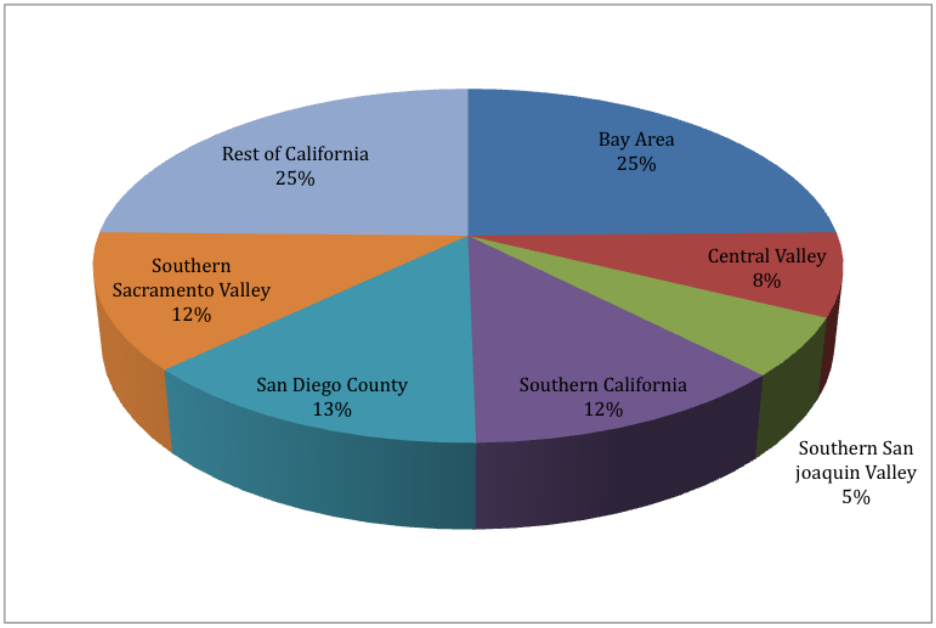


Source: Author's calculation based on data from California Office of the State Controller, *Comprehensive Annual Financial Report for the Year Ended June 30, 2007.*

Yet which Californians bear the fiscal burden of the state's expenditures? Figure 8 shows the distribution of 2005 personal income tax collections by region, which represent the latest data available. Twenty-five percent of the personal income taxes in the state are paid by residents in the three Central Valley regions considered in this report. On the other hand, the Bay Area pays 25 percent and Southern California and San Diego together pay 25 percent. The disparity in sales and use taxes that are paid is even more stark. Figure 9 shows that the Central Valley regions pay 16 percent of the overall

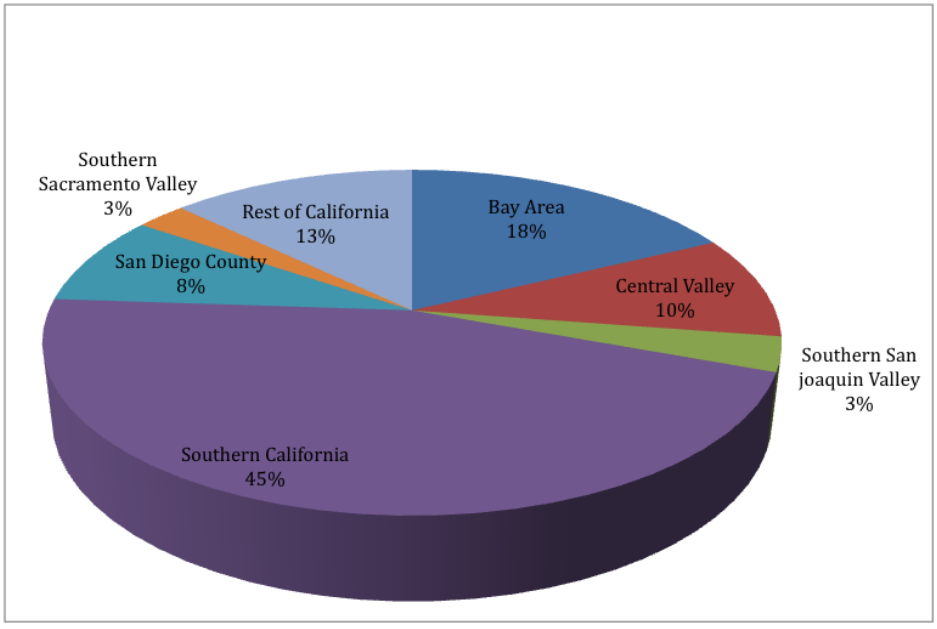
tax, while Southern California and San Diego pay 53 percent and the Bay Area contributes 18 percent.

Figure 8
Distribution of California Personal Income Tax Paid, 2005, By Region



Source: Author's calculation based on data from California Franchise Tax Board, *Annual Report, 2006*, Table B-6: Synopsis of Adjusted Gross Income by County, 2005 Taxable Year.

Figure 9
Distribution of California Sales and Use Tax Paid, 2007, By Region



Source: Author's calculation based on data from California State Board of Equalization, *Annual Report 2006-2007*, Table 20: State Sales and Use Tax Statistics, by County, 2006-07.

Nearly 48 percent of the proposed HSR track is expected to be laid in the Central Valley, a significant infrastructure investment into a region that has yet to achieve its full economic potential. Central Valley residents should view this investment as not strictly their own, but one clearly undertaken by their fellow citizens from around the state.

IV. Quality of Life Enhancements

Central Valley residents will gain unprecedented access to the major economic, cultural, and transportation hubs of the state. Frequent, efficient, fast transportation linking Central Valley residents to other multi-modal downtown stations within the region and beyond has the potential to materially alter citizens' perceptions of their travel opportunities. It is difficult to place an economic value on trips that will one day be taken, which are foregone today because of the cost in terms of time, effort, or out-of-pocket expenses.

HSR will provide obvious environmental benefits. Station placements will lead to the revitalization of downtown districts as they serve as a focal point for infill development. Cambridge Systematics (2007) estimates that HSR will have a modest impact on urbanization. Population and employment growth will of course increase the urbanized land area in all of California, yet HSR is expected to cause negligible increases in urban land areas in the Bay Area and northern Central Valley counties, and modest marginal increases in Fresno, Madera, and Merced Counties (2.2, 3.9, and 2.9 percent, respectively). The research suggests that the diminished availability of undeveloped land

in many areas, especially the Bay Area, will raise land prices and encourage denser development, infill, and redevelopment. In addition, residential densities have increased over time, a trend that is likely to continue. Finally, because the HSR system is largely expected to use existing transportation corridors, less open space will be consumed than it otherwise would with freeway development.

The other salient environmental benefit of HSR is the expected reduction in airborne pollution resulting from fewer vehicle and airplane miles travelled. Relative to the no-project alternative, various categories of pollutants from driving would be reduced 8.0 percent in the Central Valley and 1.7 percent in the Bay Area.[15] Various categories of airplane emissions would be reduced between 2.3 and 3.4 percent in the Bay Area and between 0.1 and 1.4 percent in the Central Valley.[16]

IV. Concluding Remarks

The Central Valley will experience unprecedented growth over the next 20 years, placing critical strains on existing transportation infrastructure. Decisions that are made today will have a significant influence on how Central Valley residents are able to take advantage of the economic opportunities ahead. HSR is a transportation option that has proven effective around the world in reducing automobile and airline traffic, while integrating wider geographic regions into a unified economic market. The Central Valley today is relatively inconveniently integrated into the Bay Area and Southern California. Yet HSR would change the equation. Sacramento to Los Angeles in 2:17 hours; Merced

[15] See California High-Speed Rail Authority and USDOT Federal Railroad Administration (June 2008 errata, p. 3.3-18).
[16] See California High-Speed Rail Authority and USDOT Federal Railroad Administration (June 2008 errata, p. 3.3-19).

to San Francisco in 1:14 hours, Fresno to San Diego in 2:42 hours. The HSR trip would be convenient and reliable, with numerous travel times throughout the day, cost-effective, safe, and comfortable. HSR would likely become the travel mode of choice to the major metropolitan areas of the state both intra-regionally and inter-regionally.[17]

This report has highlighted some of the most obvious economic benefits associated with implementing HSR over the alternative of expanding the freeway and airway networks. The most directly obvious cost savings accruing to Central Valley residents fall into the four categories of mode-shift benefits, congestion reduction benefits, market accessibility benefits, and the social benefits associated with reduced air pollution and accidents. The available research that combines how transportation dynamics would shift as a result of new modal options with the value people place on their time and clean air shows that these overall direct benefits could amount to approximately $3 billion, the largest of which would be the time saved from not having to sit in traffic.

As reported in many venues, Central Valley populations will increase dramatically over the next 20 years. The available research suggests that HSR will have a disproportionately positive impact on areas that are on the economic periphery at the present time, specifically Merced and Madera Counties. The research further indicates that HSR will trigger internal job creation within the Central Valley, especially in the service, transportation, communications, and utilities, and finance, insurance, and real estate, and sectors. Job growth will occur directly during the course of constructing the HSR network. With 160,000 construction-related jobs created to plan, design, and then build the HSR system at an approximate cost of $40 billion, the Central Valley economy will experience direct employment and economic multiplier benefits. It is difficult to

[17] For European evidence that bears out this prediction, see Fröidh (2005).

predict now the precise amount of this economic injection into the region, but it is reasonable to assume that the Central Valley will receive somewhere between 15 and 40 percent of the public expenditure.

One of the most important anticipated benefits from HSR is the increased level of accessibility that Central Valley areas will experience. Lower transportation and transaction costs will encourage new businesses to locate in the Central Valley where favorable costs and public policies can encourage business development. Moreover, workers will be able to seamlessly commute both to, from, and within the Central Valley. Estimates presented in this report show that the potential taxable income gains to the Central Valley economy from achieving economic integration into and parity with the rest of the state can reach nearly $48 billion per year. This added income would translate into enhanced state tax revenues of over $2 billion. Furthermore, increased household income translates into greater consumption. Research presented in this report estimates that total sales/use taxes would increase by approximately $333 million per year, of which nearly $46 million would flow directly to counties and cities within the Central Valley.

HSR stations would serve as a magnet for local agglomeration economies to develop within the Central Valley region. Economic research uniformly finds that transportation convenience and accessibility is a key determinant of real property values, both residential and commercial. HSR is predicted to have a positive impact on property values, yet research on HSR's impact elsewhere in the world shows the importance of land-use planning policies that steer growth toward infill and redevelopment efforts.

Such development will have a self-reinforcing effect in consolidating the economic benefits associated with the placement of a HSR station in a community.

Finally, the study highlighted some of the more subtle anticipated benefits of HSR. First, HSR represents a major infrastructure investment in the Central Valley, which has great potential as an economic power within the state, beyond its traditional role in agriculture. Yet, because of the distribution of income and wealth within the state, Central Valley residents and taxpayers will pay a disproportionately diminished share of the revenue needed to fund HSR in California. Indeed, California voters outside the Central Valley should be willing to support such an investment as the returns, estimated above, can far outstrip their expenditures. Second, the study highlighted some of the quality of life benefits associated with HSR. One of the most significant benefits associated with HSR's ability to reduce the amount of traffic on the roads is the resulting reduction in pollutants, not only in the Central Valley but also in the Bay Area that serves as a source of pollution for inland regions. Finally, HSR will use less open-space land than the alternative – freeway construction – and the location of HSR stations can serve as a focus point for sustainable local development.

REFERENCES CONSULTED

Aschauer, David A., "Is Pubic Expenditure Productive?" *Journal of Monetary Economics* 23 (1989), 177-200.

Baird, Brian A., Public Infrastructure and Economic Productivity: A Transportation-Focused Review," *Transportation Research Record* no. 1932 (2005), 54-60.

California High-Speed Rail Authority and USDOT Federal Railroad Administration, "Final Bay Area to Central Valley High-Speed Train (HST) Program Environmental Impact Report/Environmental Impact Statement (EIR/EIS). Volume 1: Report," May 2008.

California Partnership for the San Joaquin Valley, *Strategic Action Proposal*, October 2006.

Cambridge Systematics, "Economic Growth Effects Analysis for the Bay Area to Central Valley Program-Level Environmental Impact Report and Tier 1 Environmental Impact Statement," Report prepared for the California High-Speed Rail Authority, July 2003 and July 2007.

_____, "Bay Area/California High-Speed Rail Ridership and Revenue Forecasting Study," Report prepared for the Metropolitan Transportation Commission and the California High-Speed Rail Authority, August 2007.

Center for Global Metropolitan Studies, University of California, Berkeley, "Transit Oriented Development for High Speed Rail (HSR) in the Central Valley, California: Design Concepts for Stockton and Merced" (July 31, 2008).

Cervero, Robert, "Rail Transit and Joint Development: Land Market Impacts in Washington, D.C. and Atlanta," *Journal of the American Planning Association* 60 (1994), 83-94.

Cervero, Robert, and Michael Duncan, "Transit's Value-Added: Effects of Light and Commuter Rail Services on Commercial Land Values," Working paper, Department of City and Regional Planning, University of California, Berkeley, November 2001.

_____, "Land Value Impacts of Rail Transit Services in Los Angeles County," Report prepared for the National Association of Realtors, June 2002.

_____, "Land Value Impacts of Rail Transit Services in San Diego County," Report prepared for the National Association of Realtors, June 2002.

Chandra, Amitabh, and Eric Thompson, "Does Public Infrastructure Affect Economic Activity? Evidence from the Rural Interstate Highway System," *Regional Science and Urban Economics* 30 (2000), 457-90.

de Rus, Ginés, "Is Investment in High Speed Rail Socially Profitable?" University of Las Palmas (Spain) Working paper, April 2005.

_____, "The Economic Effects of High Speed Rail Investment," Joint Transport Research Centre Discussion Paper 2008-16, August 2008.

Economic Research Associates, "Transit Station Area Market Study Prepared for Capital Metropolitan Transportation Authority" (January 2006). Available at http://allsystemsgo.capmetro.org/public-education-materials.shtml

Eichinger, Andreas, and Andreas Knorr, "Potential and Limitations of Air-rail Links: A General Overview," Institute for World Economics and International Management, Band 34, October 2004.

Fröidh, Oskar, "Market Effects of Regional High-speed Trains on the Svealand Line," *Journal of Transport Geography* 13 (2005), 352-61.

Garmendia, Maddi, José M. de Ureña, Cecilia Ribalaygua, Jesús Leal, and José M. Coronado, "Urban Residential Development in Isolated Small Cities That Are Partically Integrated in Metropolitan Areas by High Speed Train," *European Urban and Regional Studies* 15 (2008), 249-64.

Givoni, Moshe, "Development and Impact of the Modern High-speed Train: A Review," *Transport Reviews* 26 (Sept. 2006), 593-611.

Goodbody Economic Consultants, "Transport and Regional Development," 2000.

Graham, Daniel J., "Investigating the Link Between Productivity and Agglomeration for UK Industries," Imperial College, London, Working paper, December 2005.

_____, "Variable Returns to Agglomeration and the Effect of Road Traffic Congestion," *Journal of Urban Economics* 62 (2007), 120-

Gutiérrez, Javier, Rafael González, and Gabriel Gómez, "The European High-speed Train Network: Predicted Effects on Accessibility Patterns," *Journal of Transport Geography* 4 (1996), 227-38.

Haynes, Kingsley E., "Labor Markets and Regional Transportation Improvements: The Case of High-Speed Trains," *Annals of Regional Science* 31 (1997), 57-76.

Infrastruc2ture Management Group/Lehman Brothers Team, "Preliminary Funding Strategy and Finance Plan: Bay Area to Anaheim Segments" (May 23, 2007).

Laird, James J., John Nellthorp, and Peter J. Mackie, "Network Effects and Total Economic Impact in Transport Appraisal," *Transport Policy* 12 (2005), 537-44.

Levinson, David, David Gillen, Adib Kanafani, and Jean-Michel Mathieu, "The Full Cost of Intercity Transportation: A Comparison of High Speed Rail, Air and Highway Transportation in California," University of California, Berkeley Research Report UCB-ITS-RR-96-3, June 1996.

Levinson, David, Adib Kanafani, and David Gillen," Air, High Speed Rail, or Highway: A Cost Comparison in the California Corridor," *Transportation Quarterly* 53 (1999), 123-32.

Martin, Fernand, "Justifying a High-speed Rail Project: Social Value vs. Regional Growth," *Annals of Regional Science* 31 (1997), 155-74.

Martín, Juan Carlos, and Aura Reggiani, "Recent Methodological Developments to Measure Spatial Interaction: Synthetic Accessibility Indices Applied to High-speed Train Investments," *Transport Reviews* 27 (Sept. 2007), 551-71.

Munnell, Alicia H., "Why Has Productivity Growth Declined? *New England Economic Review* (January/February 1990a), 3-22.

_____, "How Does Public Infrastructure Affect Regional Economic Performance?" In A. H. Munnell, ed., *Is There a Shortfall in Public Capital Investment?* (Boston: Federal Reserve Bank of Boston, 1990b).

Nadiri, M. Ishaq, and Theofanis P. Mamuneas, "The Effects of Public Infrastructure and R&D Capital on the Cost Structure and Performance of U.S. Manufacturing Industries," *Review of Economics and Statistics* 76 (1994), 22-37.

Park, Yonghwa, and Hun-Koo Ha, "Analysis of the Impact of High-speed Railroad Service on Air Transport Demand," *Transportation Research Part E* 42 (2006), 95-104.

Porter, Michael E., "The Economic Performance of Regions," *Regional Studies* 37 (2003), 549-78.

Rietvald, Piet, "Employment Effects of Changes in Transportation Infrastructure: Methodological Aspects of the Gravity Model," *Papers of the Regional Science Association* 66 (1989), 19-30.

Rietvelt, P., F. R. Bruinsma, H. T. van Delft, and B. Ubbels, "Economic Impacts of High Speed Trains: Experiences in Japan and France, Expectations in The Netherlands," University of Amsterdam Research Memorandum 2001-20, June 2001.

Román, Concepción, Raquel Espino, and Juan Carlos Martín, "Competition of High-speed train with Air Transport: The Case of Madrid-Barcelona," *Journal of Air Transport Management* 13 (2007), 277-84.

Sands, Brian D., "The Development Effects of High-speed Rail Stations and Implications for California," University of California (Berkeley) Transportation Center, Working paper UCTC No. 115, April 1993.

Sasaki, Komei, Tadahiro Ohashi, and Asao Ando, "High-speed Rail Transit Impact on Regional Systems: Does the *Shinkansen* Contribute to Dispersion?" *Annals of Regional Science* 31 (1997), 77-98.

Schwanen, Tim, and Patricia L. Mokhtarian, "Attitudes toward Travel and Land Use and Choice of Residential Neighborhood Type: Evidence from the San Francisco Bay Area," *Housing Policy Debate* 18 (2007), 171-207.

Thompson, Louis S., "High-Speed Rail (HSR) in the United States – Why Isn't There More?" *Japan Railway & Transport Review* (October 1994), 32-39.

Vickerman, Roger, "High-speed Rail in Europe: Experience and Issues for Future Development," *Annals of Regional Science* 31 (1997), 21-38.

_____, "Indirect and Wider Economic Impacts of High-Speed Rail," Paper prepared for the Fourth Annual Conference on Railroad Industrial Structure, Competition and Investment, Madrid, Spain, October 2006.